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Rural Municipality of Victoria Beach

Information Bulletin 99-28

Soils and Terrain

An introduction
to the land resource

Land Resource Unit
Brandon Research Centre

Canada

Rural Municipality of Victoria Beach

Information Bulletin 99-28

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PREFACE

This is one of a new series of information bulletins for individual rural municipalities of Manitoba. They serve to introduce the newly developed digital soil databases and illustrate several typical derived and interpretive map products for agricultural land use planning applications. The bulletins will also be available in diskette format for each rural municipality.

Information contained in this bulletin may be quoted and utilized with appropriate reference to the originating agencies. The authors and originating agencies assume no responsibility for the misuse, alteration, re-packaging, or re-interpretation of the information.

This information bulletin serves as an introduction to the land resource information available for the municipality. More detailed information, including copies of the primary soil and terrain maps at larger scales, may be obtained by contacting

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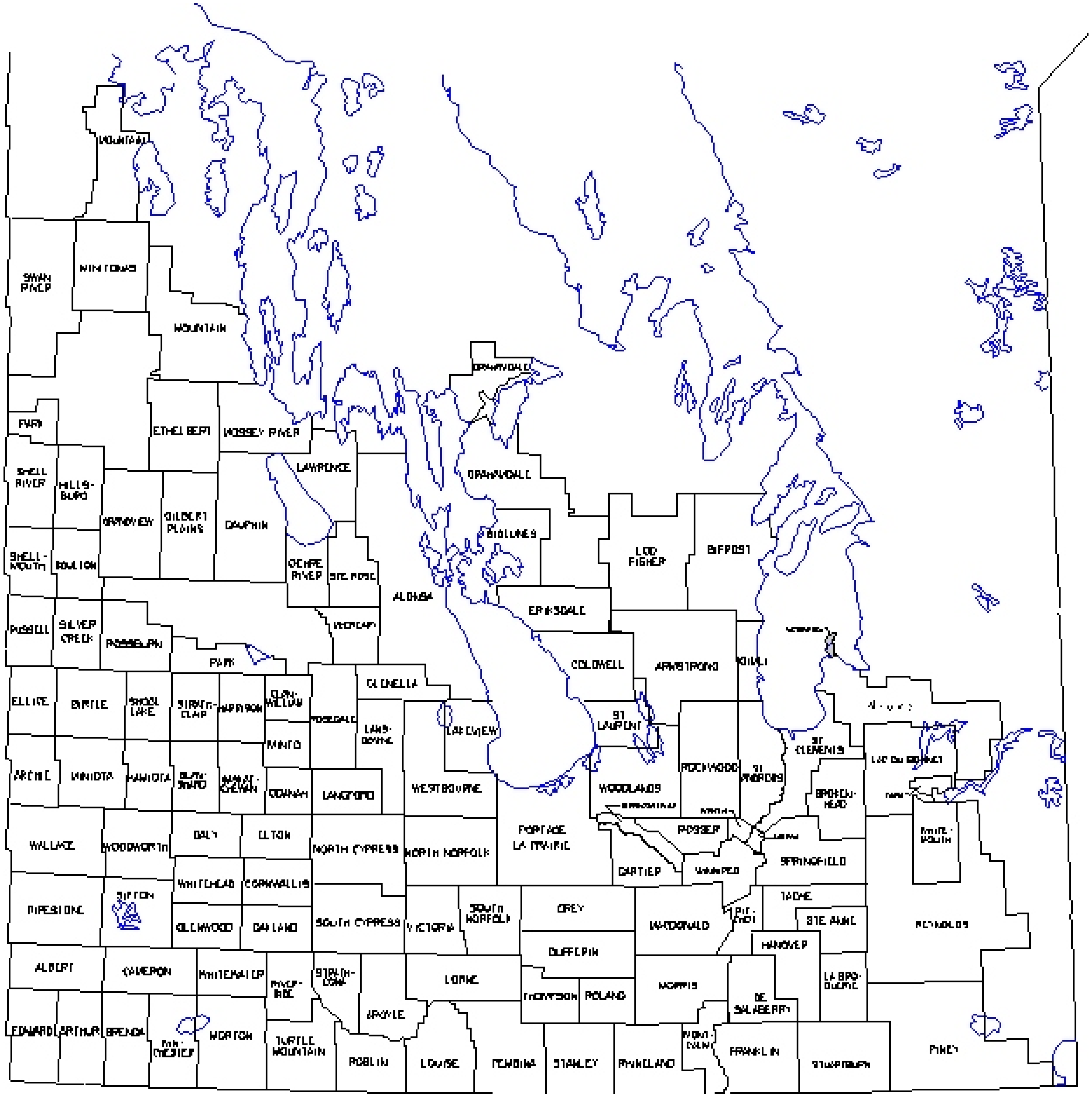


Figure 1. Rural municipalities of southern Manitoba.

INTRODUCTION

The location of the Rural Municipality of Victoria Beach is shown in Figure 1. A brief overview of the database information, and general environmental conditions for the municipality are presented. A set of maps derived from the data for typical agricultural land use and planning applications are also included.

The soil map and database were compiled and registered using the Geographic Information System (PAMAP GIS) facilities of the Land Resource Unit. These databases were used in the GIS to create the generalized, derived and interpretive maps and statistics in this report. The final maps were compiled and printed using Coreldraw.

This bulletin is available in printed or digital format. The digital bulletin is a Windows based executable file which offers additional display options, including the capability to print any portion of the bulletin.

LAND RESOURCE DATA

The soil and terrain information presented in this bulletin was compiled as part of a larger project to provide a uniform level of land resource information for agricultural and regional planning purposes throughout Agro-Manitoba. This information was compiled and analysed in two distinct layers as shown in Figure 2.

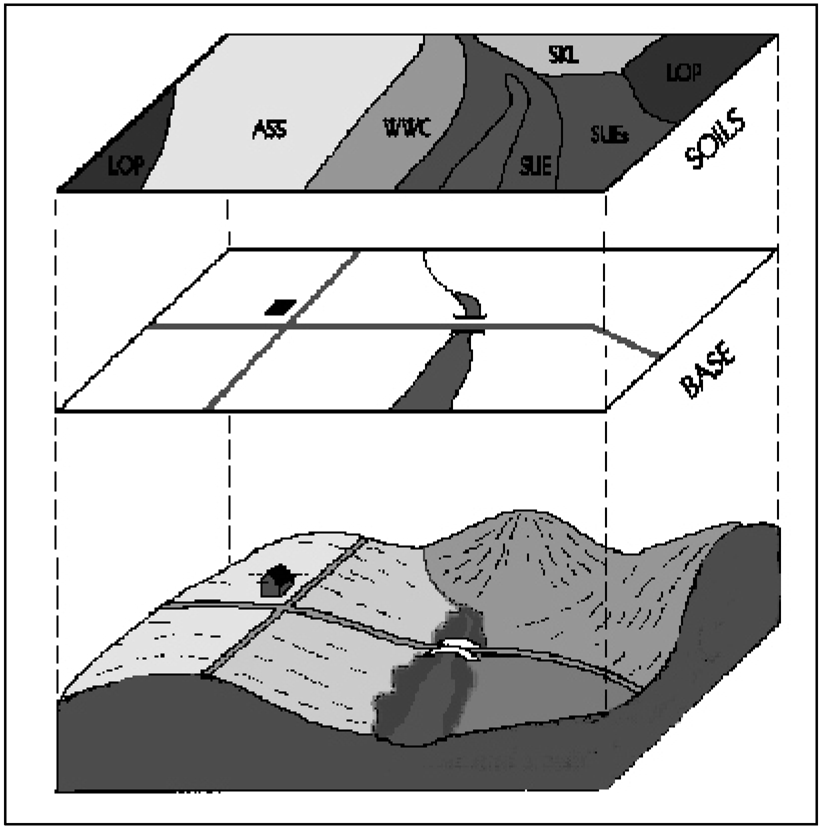


Figure 2. Soil and Base Map data.

Base Layer

Digital base map information includes the municipality and township boundaries, along with major streams, roads and highways. Major rivers and lakes from the base layer were also used as common boundaries for the soil map layer. Water bodies larger than 25 ha in size were digitized as separate polygons.

Soil Layer

The most detailed soil information currently available was selected as the data source for the digital soil layer for each rural municipality.

Comprehensive detailed soil maps (1:20 000 to 1:50 000 scale) have been published for many rural municipalities. Where they were available, the individual soil map sheets were digitized and compiled as a single georeferenced layer to match the digital RM base. Map polygons have one or more soil series components, as well as slope and stoniness classes. Soil database information was produced for each polygon, to meet national standards (MacDonald and Valentine, 1992). Slope length classes were also added.

Older, reconnaissance scale soil maps (1:126 720 scale) represented the only available soil data source for many rural municipalities. These maps were compiled on a **soil association** basis, in which soil landscape patterns were identified with unique surficial geological deposits and textures. Each soil association consists of a range of different soils ("associates") each of which occurs in a repetitive position in the landscape. Modern soil series that best represent the soil association were identified for each soil polygon. The soil and modifier codes provide a link to additional databases of soil properties. In this way, both detailed and reconnaissance soil map polygons were related to soil drainage, surface texture, and other soil properties to produce various interpretive maps. Slope length classes were also added.

SOIL AND TERRAIN OVERVIEW

The Rural Municipality (RM) of Victoria Beach covers an area of 2 122 hectares (approximately 1.4 townships) located immediately west of Traverse Bay in the south basin of Lake Winnipeg (page 3). It consists of the Victoria Beach peninsula and includes Elk Island located immediately north of the peninsula. The mainland portion of the municipality is largely used for cottage development and recreational homes. The most densely developed area known as Victoria Beach is on the west side of the peninsula where cottage development has been in place for many years. Although other areas on the peninsula have recently undergone subdivision for cottage development, a large tract of forest land occupies the central portion of the peninsula. In contrast, Elk Island remains largely in the natural state and has been designated as a Provincial Heritage Park.

The climate in the area can be related to weather data from Pine Falls. The mean annual temperature is 1.9˚C and the mean annual precipitation is 522 mm (Environment Canada, 1993). The average frost-free period is 107 days and degree-days above 5˚C accumulated from May to September average 1579 (Ash, 1991). An evaluation of growing conditions in this region of Manitoba can be related to estimates of seasonal moisture deficit and effective growing degree-days (EDD) above 5˚C. The seasonal moisture deficit calculated between May and September is slightly greater than 200 mm and the estimated effective growing degree-days accumulated from May to September range from 1300 to 1400 (Agronomic Interpretations Working Group, 1995). These parameters provide an indication of moisture and heat energy available for crop growth and are generally adequate to support a wide range of crops adapted to western Canada.

Physiographically, the RM of Victoria Beach is located in the north portion of the Lac Du Bonnet Plain Section of the Canadian Shield. Both Victoria Beach peninsula and Elk Island consist of prominent uplands with a moderately hummocky to very gently undulating surface (Canada-Manitoba Soil Survey, 1980). Elevation of the land surface ranges from approximately 217 metres above sea level (m asl) at lake level to 247 m asl on Elk Island and 235 m asl on the Victoria Beach peninsula. Elevations decrease sharply along most of the shoreline although the south shore of both land areas is characterized by low-lying marshy areas. Except for the shoreline areas, local relief is generally under 3 metres and slopes are dominantly less than 2 percent (page 9). Gently sloping terrain with 2 to 5 percent slopes is dominant although local areas of 5 to 9 percent slopes occur and the north shore of Elk Island is strongly sloping. Sandy surface textures are dominant although small areas of clayey textured materials and thin sandy deposits underlain by clay occur at lower elevations (page 11). There are no creeks or rivers in the area, but most of the soils are well drained due to the dominance of coarse textured, highly permeable surficial materials (page 13). Subsurface water movement results in localized seepage in lower slope positions. Internal drainage is impeded on level to very gently sloping areas of fine textured soils and areas of sandy deposits underlain by clayey materials at shallow depths causing local areas of wet to very wet conditions.

Soil materials in the municipality were deposited during the last glaciation and during the time of glacial Lake Agassiz. The Lac Du Bonnet Plain in this area consists of deep deposits of sandy and gravelly glacio-fluvial outwash deposits and waterworked, stony, sandy loam to loam textured glacial till. Stratigraphic and textural variation of the sandy deposits is described by four variants ranging in texture from very fine sand to stratified coarse and fine sand with gravelly subsoils. Local areas of waterworked, stony, sandy loam to loam textured glacial till occur intermixed with sandy lacustrine and glacio-fluvial deposits. Clayey sediments and thin sandy materials underlain by lacustrine clay may occur at lower elevations along the shoreline (page 11). The undulating to ridged topography and the dominance of coarse textured materials throughout the municipality results in the majority of soils being classified as well to rapidly drained (page 13).

Soils in the municipality have been mapped at a detailed level (1:20 000 scale) and published in the soil survey report for the Victoria Beach - Elk Island area (Veldhuis, 1990). Reconnaissance level (1:126 720 scale) map information for the Lac Du Bonnet area is also available (Smith et al., 1967). According to the Canadian System of Soil Classification (Expert Committee on Soil Survey, 1997), Eluviated Dystric Brunisol soils of the Sandilands series developed on sandy deposits in well to rapidly drained sites are dominant. Gray Luvisols (St. Labre, Caliento, Woodridge and Wampum series) occur on well to imperfectly drained calcareous deposits and poorly drained clayey textured deposits are characterized by Humic Gleysol soils of the Fyala and Tarno series.

Major management considerations are related to coarse texture, droughtiness and stoniness (page 17). Local areas of very poorly drained marsh occur at lake level on the south end of Elk Island and adjacent to the low-lying sand beach connecting the peninsula to the mainland. Seasonal high water tables (at 1 to 2 metres) and saturated soils occur in local level to depressional areas and in lower slope positions affected by seepage. Well drained sandy soils are subject to potential wind erosion if the vegetation is removed. Exceedingly stony and bouldery conditions are associated with the soils of the Richer complex. Soils throughout the municipality are non-saline.

The majority of the soils (76 percent) are rated in **Class 5** for agricultural capability due to droughtiness, steep slopes, stoniness and wetness. Soils with moderate to severe limitations of low moisture holding capacity are placed in **Class 3** and **Class 4** and steeply sloping soils, marshes and sand beaches are rated in **Class 7 (**page 19). The irrigation suitability of soils in this municipality is dominantly **Fair** (66 percent) due to coarse texture and **Poor** (29 percent) due to very coarse texture, steep slope or poor drainage (page 21).

One of the issues currently receiving considerable attention is the sustainability of agricultural practices and their potential impact on the soil and groundwater environment. To assist in highlighting this concern to land planners and agricultural producers, an assessment of potential environmental impact (EI) under irrigation is shown on page 23. The dominance of sandy soils with high permeability and risk of deep leaching results in a dominantly **High** potential risk of adverse impact on the environment under irrigation . This EI map is intended to be used in association with the irrigation suitability map.

Another issue of concern to producers, soil conservationists and land use specialists is soil erosion caused by agricultural cropping and tillage practices. Areas with potential for water erosion are shown on page 25. About 94 percent of the land in the municipality is at a **Negligible** risk of degradation due to water erosion as the dominantly coarse textures result in rapid infiltration and minimal surface runoff. However, the extensive areas of sandy soils in the municipality are at a greater risk of erosion by wind if the soil surface is not protected by vegetation. Management practices during cottage development focus on maintaining adequate vegetative cover to adequately protect the soils from both wind and water erosion.

The majority of soils in the RM of Victoria Beach have very severe limitations for arable agriculture and severe to very severe limitations for both agriculture and production of commercial forests. However, recreational development of the area is compatible with the natural soil and terrain limitations and is able to take advantage of water based activities associated with Lake Winnipeg. Woodlands consisting of mixed deciduous and coniferous forest provide cottage sites which tend to concentrate close to the shoreline area of the Victoria Beach peninsula. Some logging for firewood is carried out in the central forested area which provides wildlife habitat and additional opportunities for recreation. The marsh wetlands at the south end of Elk Island and the Victoria Beach peninsula support recreation activities related to waterfowl and wildlife. Elk Island, protected as a natural heritage area, remains in its natural forest state.

DERIVED AND INTERPRETIVE MAPS

A large variety of computer derived and interpretive maps can be generated from the digital soil and landscape databases. These maps are based on selected combinations of database values and assumptions.

Derived maps show information that is given in one or more columns in the computer map legend (such as soil drainage, soil salinity, or slope class).

Interpretive maps portray more complex land evaluations based on a combination of soil and landscape information. Interpretations are based on soil and landscape conditions in each polygon. Interpretative maps typically show land capabilities, suitabilities, or risks related to sustainability.

Several examples of derived and interpretive maps are included in this information bulletin:

<u>Derived Maps</u>
Slope
Surface Texture
Drainage
Salinity
Management Considerations

<u>Interpretative Maps</u>
Agricultural Capability
Irrigation Suitability
Potential Environmental Impact
Water Erosion Risk

The maps have all been reduced in size and generalized (simplified) in order to portray conditions for an entire rural municipality on one page. These generalized maps provide a useful overview of conditions within a municipality, but are not intended to apply to site specific land parcels. On-site evaluations are recommended for localized site specific land use suitability requirements.

Digital databases derived from recent detailed soil inventories contain additional detailed information about significant inclusions of differing soil and slope conditions in each map polygon. This information can be portrayed at larger map scale than shown in this bulletin.

Information concerning particular interpretive maps, and the primary soil and terrain map data, can be obtained by contacting the Manitoba Soil Resource Section of Manitoba Agriculture, the local PFRA office, or the Manitoba Land Resource Unit.

Slope Map.

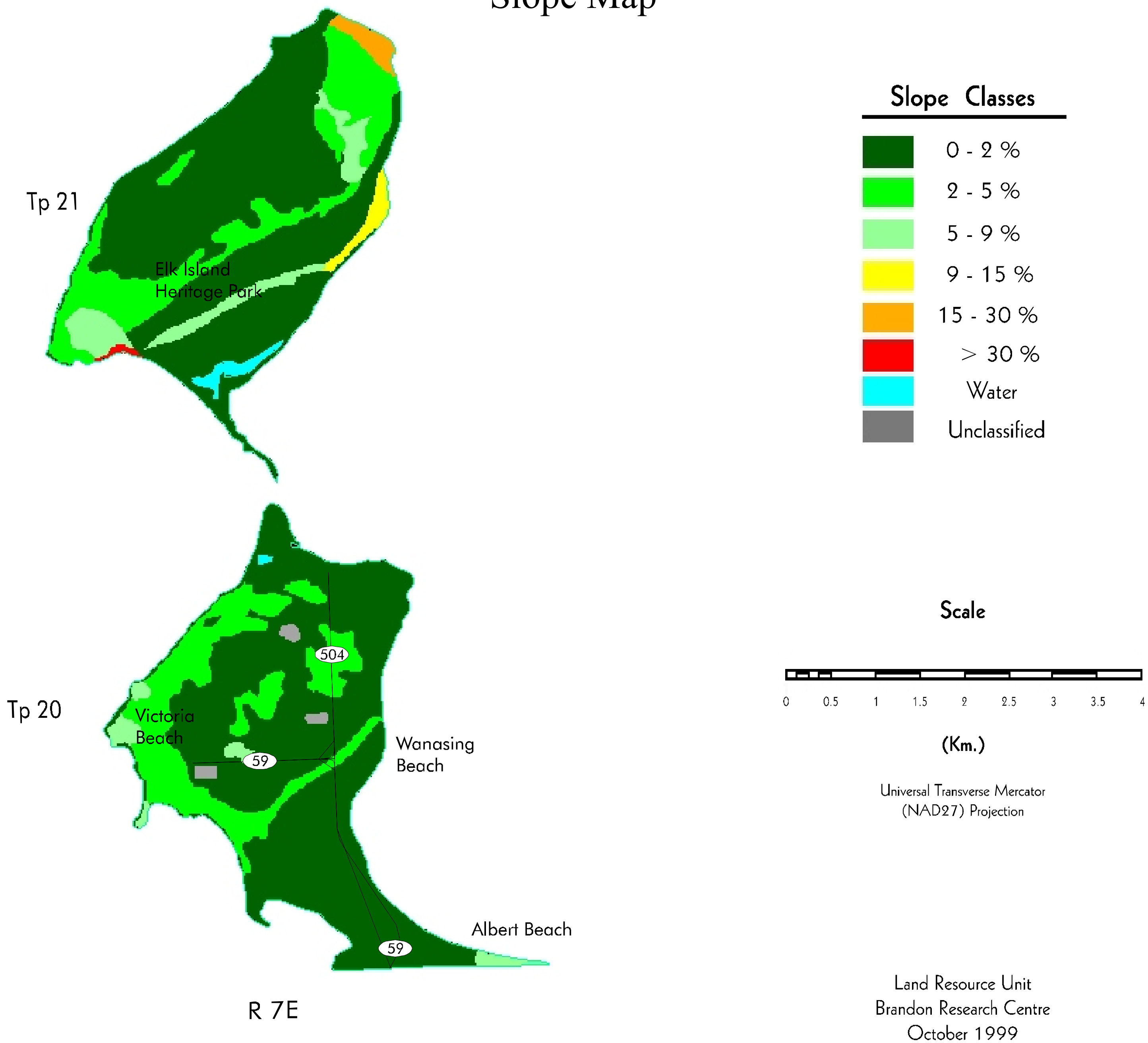
Slope describes the steepness of the landscape surface. The slope classes shown on this map are derived from the digital soil and terrain layer database. Specific colours are used to indicate the dominant slope class for each polygon in the RM. Additional slope classes may occur in each polygon area, but cannot be portrayed at this reduced map scale.

Table 1. Slope Classes[1]

Slope Class	Area (ha)	Percent of RM
0 - 2 %	1481	69.8
2 - 5 %	466	22.0
5 - 9 %	108	5.1
9 - 15 %	19	0.9
15 - 30 %	20	0.9
> 30 %	4	0.2
Unclassified	10	0.5
Water	14	0.7
Total	2122	100.0

[1] Area has been assigned to the dominant slope in each soil polygon.

Slope Map


Tp 21
Elk Island
Heritage Park
Tp 20
Victoria
Beach
504
59
Wanasing
Beach
Albert Beach
59
R 7E
Slope Classes
0 - 2 %
2 - 5 %
5 - 9 %
9 - 15 %
15 - 30 %
> 30 %
Water
Unclassified
Scale
0 0.5 1 1.5 2 2.5 3 3.5 4
(Km.)
Universal Transverse Mercator
(NAD27) Projection
Land Resource Unit
Brandon Research Centre
October 1999

Surface Texture Map.

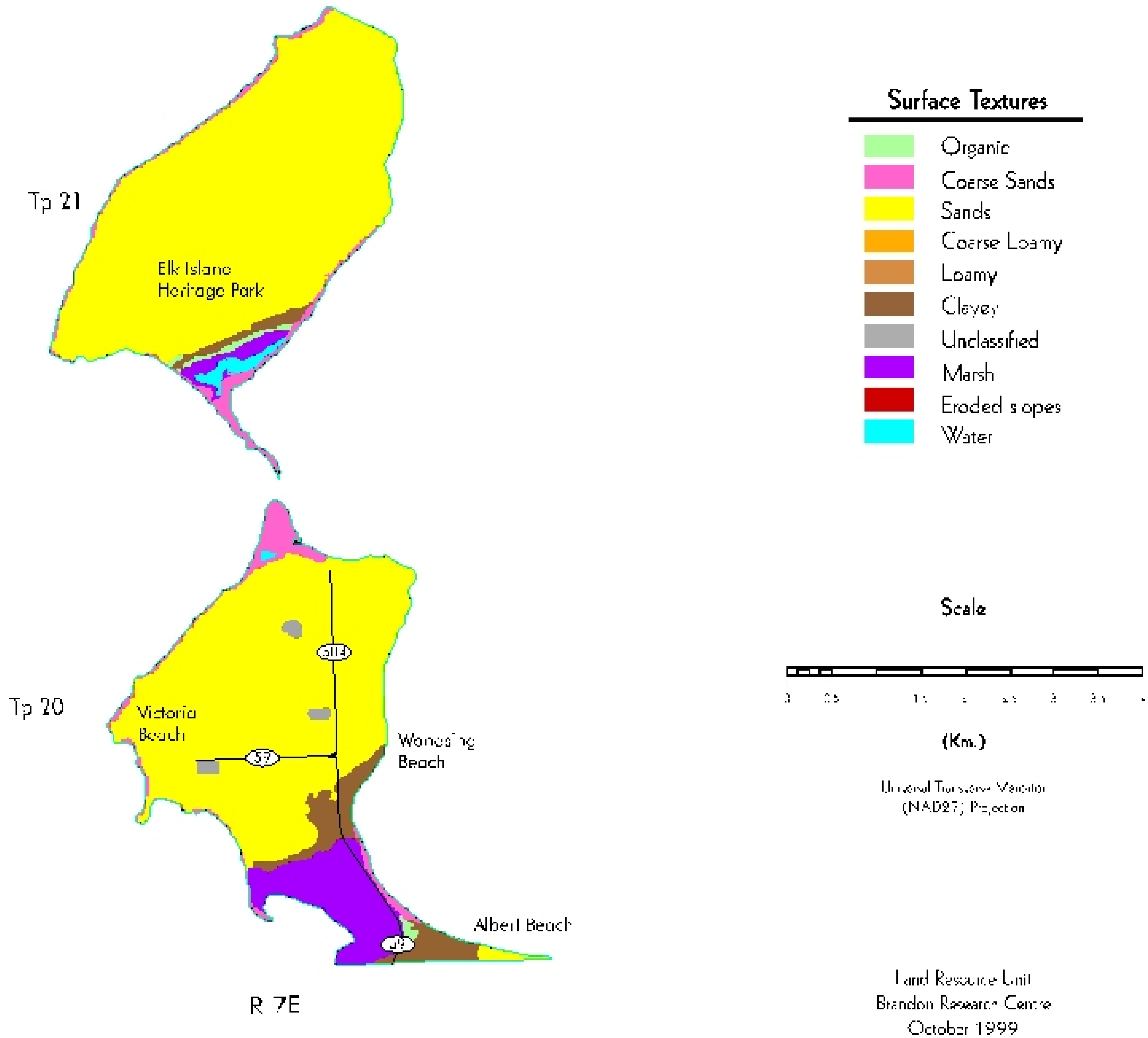
The soil textural class for the upper most soil horizon of the dominant soil series within a soil polygon was utilized for classification. Texture may vary from that shown with soil depth and location within the polygon.

Table 2. Surface Texture[1]

Surface Texture	Area (ha)	Percent of RM
Organics	**13**	**0.6**
Coarse Sands	**110**	**5.2**
Sands	**1731**	**81.6**
Coarse Loamy	**0**	**0.0**
Loamy	**0**	**0.0**
Clayey	**94**	**4.5**
Eroded Slopes	**0**	**0.0**
Marsh	**149**	**7.0**
Unclassified	**10**	**0.5**
Water	**14**	**0.7**
Total	**2122**	**100.0**

[1] Based on the **dominant** soil series for each soil polygon.

Surface Texture Map



Soil Drainage Map.

Drainage is described on the basis of actual moisture content in excess of field capacity, and the length of the saturation period within the plant root zone. Five drainage classes plus three land classes are shown on this map.

Very Poor - Water is removed from the soil so slowly that the water table remains at or on the soil surface for the greater part of the time the soil is not frozen. Excess water is present in the soil throughout most of the year.

Poor - Water is removed so slowly in relation to supply that the soil remains wet for a large part of the time the soil is not frozen. Excess water is available within the soil for a large part of the time.

Poor, drained - Water is removed slowly in relation to supply and the soil remains wet for a significant portion of the growing season. Although these soils may retain characteristics of poor internal drainage, extensive surface drainage improvements enable these soils to be used for annual crop production.

Imperfect - Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly down the profile if precipitation is the major source.

Well - Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying materials or laterally as subsurface flow.

Rapid - Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep slopes during heavy rainfall.

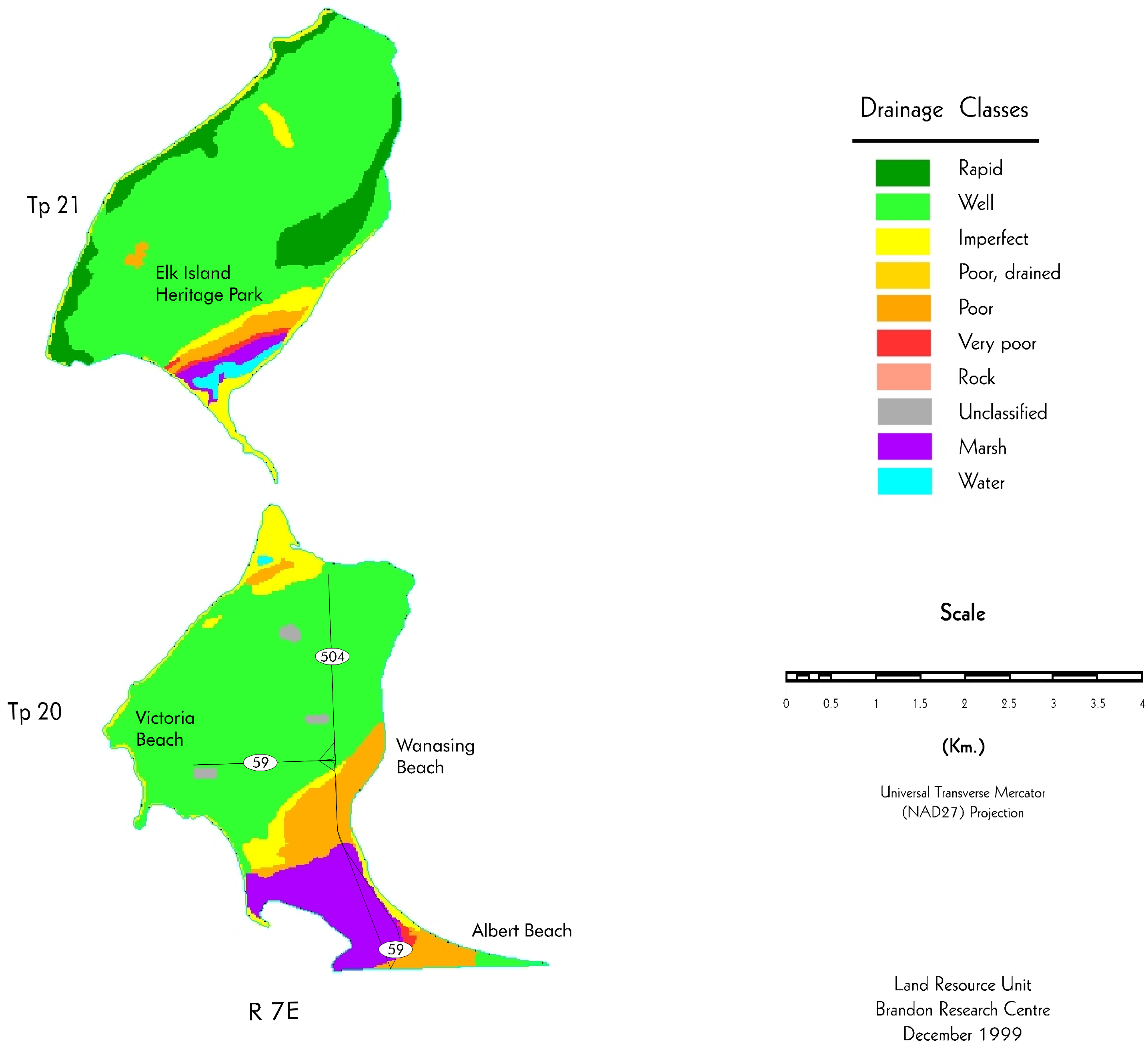
Drainage classification is based on the dominant soil series within each individual soil polygon.

Table 3. Drainage Classes[1]

Drainage Class	Area (ha)	Percent of RM
Very Poor	13	0.6
Poor	156	7.3
Poor, drained	0	0.0
Imperfect	183	8.6
Well	1455	68.6
Rapid	141	6.6
Rock	0	0.0
Marsh	149	7.0
Unclassified	10	0.5
Water	14	0.7
Total	2122	100.0

[1] Area has been assigned to the dominant drainage class for each soil polygon.

Soil Drainage Map



Soil Salinity Map.

A saline soil contains soluble salts in such quantities that they interfere with the growth of most crops. Soil salinity is determined by the electrical conductivity of the saturation extract in decisiemens per metre (dS/m). Approximate limits of salinity classes are:

non-saline	< 4 dS/m
weakly saline	4 to 8 dS/m
moderately saline	8 to 15 dS/m
strongly saline	> 15 dS/m

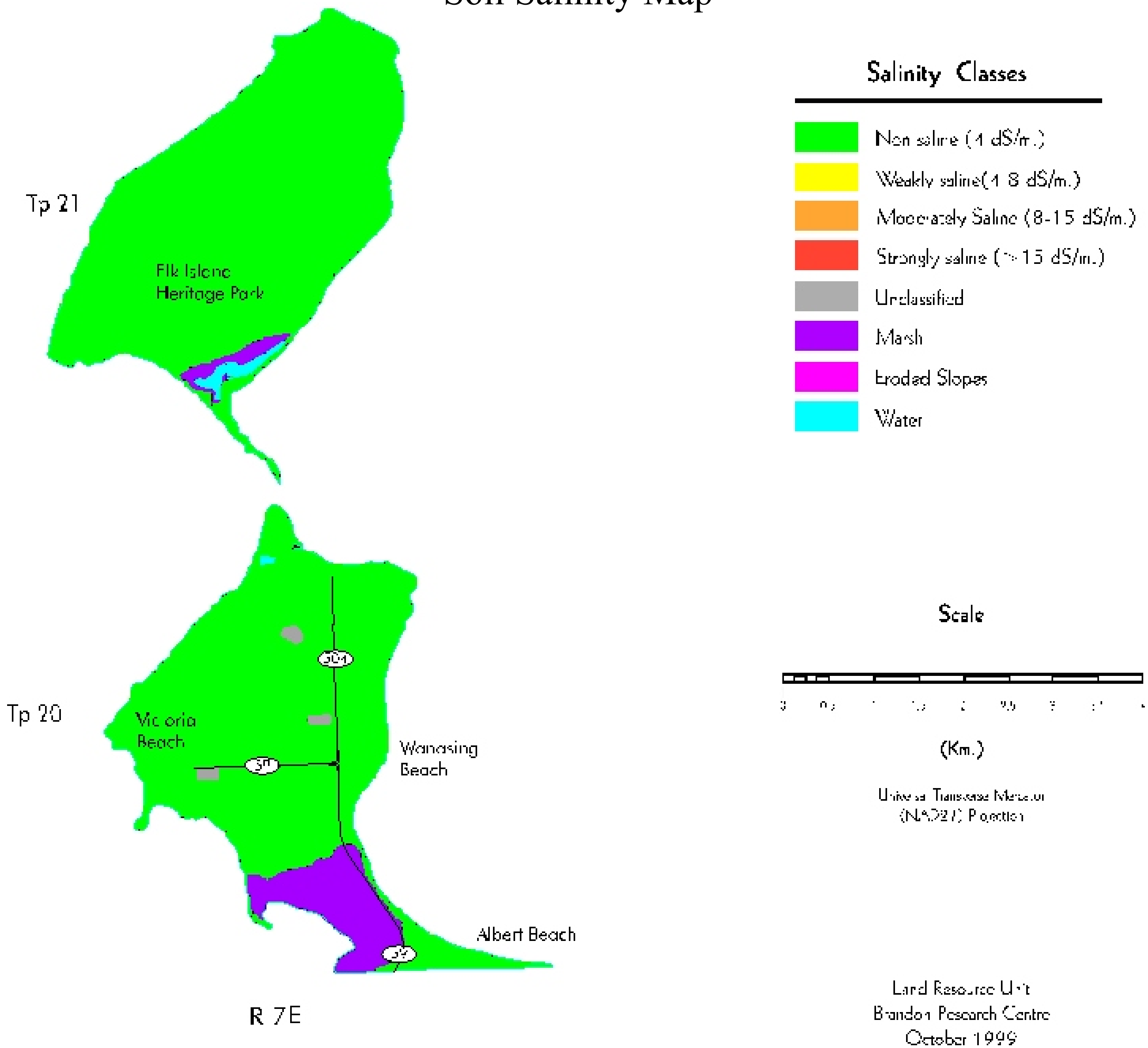
The salinity classification of each individual soil polygon was determined by the most severe salinity classification present within that polygon.

Table 4. Salinity Classes[1]

Salinity Class	Area (ha)	Percent of RM
Non Saline	**1948**	**91.8**
Weakly Saline	**0**	**0.0**
Moderately Saline	**0**	**0.0**
Strongly Saline	**0**	**0.0**
Eroded Slopes	**0**	**0.0**
Marsh	**149**	**7.0**
Unclassified	**10**	**0.5**
Water	**14**	**0.7**
Total	**2122**	**100.0**

[1] Area has been assigned to the most severe salinity class for each soil polygon.

Soil Salinity Map



Management Considerations Map.

Management consideration maps are provided to focus on awareness of land resource characteristics important to land use. This map does not presume a specific land use. Rather it portrays the most common and wide spread attributes that apply to most soil landscapes in the province.

These maps **highlight attributes** of soil-landscapes that the land manager must consider for any intended land use.

- **Fine texture**
- **Medium texture**
- **Coarse texture**
- **Topography**
- **Wetness**
- **Organic**
- **Bedrock**

F = Fine texture - soil landscapes with **fine textured soils (clays and silty clays)**, and thus low infiltration and internal permeability rates. These require special considerations to mitigate surface ponding (water logging), runoff, and trafficability. Timing and type of tillage practices used may be restricted.

M = Medium texture - soil landscapes with medium to moderately fine textures **(loams to clay loams)**, and good water and nutrient retention properties. Good management and cropping practices are required to minimize leaching and the risk of erosion.

C = Coarse texture - soil landscapes with **coarse to very coarse textured soils (loamy sands, sands and gravels)**, have a high permeability throughout the profile, and require special management practices related to application of agricultural chemicals, animal wastes, and municipal effluent to protect and sustain the long term quality of the soil and water resources. The risk of soil erosion can be minimized through the use of shelterbelts and maintenance of crop residues.

T = Topography - soil landscapes with **slopes greater than 5 %** are steep enough to require special management practices to minimize the risk of erosion.

W = Wetness - soil landscapes that have **poorly drained soils and/or >50 % wetlands** (due to seasonal and annual flooding, surface ponding, permanent water bodies (sloughs), and/or high water tables), require special management practices to mitigate adverse impact on water quality, protect subsurface aquifers, and sustain crop production during periods of high risk of water logging.

O = Organic - soil landscapes with organic soils, requiring special management considerations of drainage, tillage, and cropping to sustain productivity and minimize subsidence and erosion.

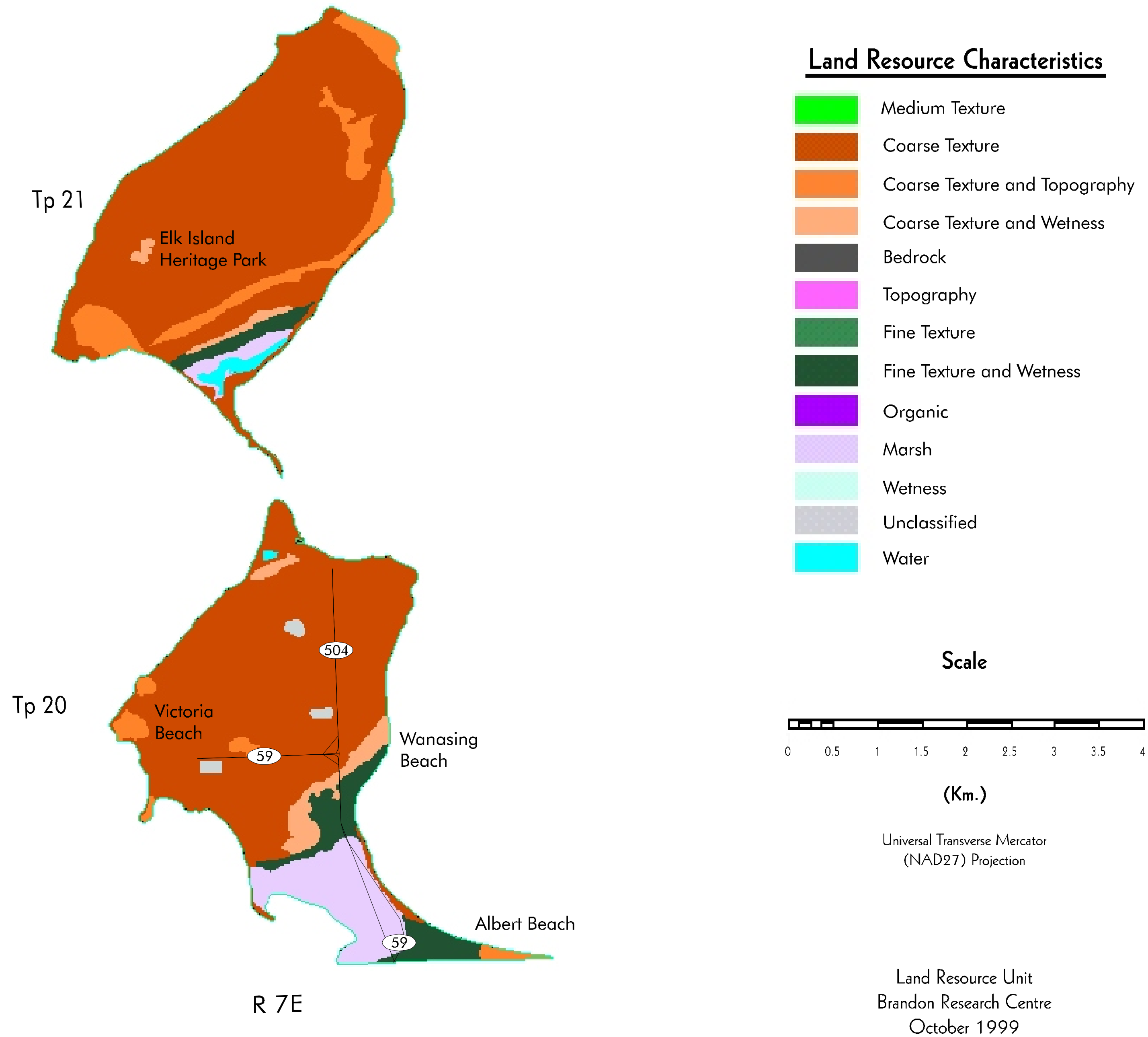
R = Bedrock - soil landscapes that have shallow depth to bedrock (< 50 cm) and/or exposed bedrock which may prevent the use of some or all tillage practices as well as the range of potential crops. They require special cropping and management practices to sustain agricultural production.

Table 4. Management Considerations[1]

Land Resource Characteristics	Area (ha)	Percent of RM
Fine Texture	0	0.0
Fine Texture and Wetness	108	5.1
Fine Texture and Topography	0	0.0
Medium Texture	0	0.0
Coarse Texture	1629	76.8
Coarse Texture and Wetness	61	2.9
Coarse Texture and Topography	151	7.1
Topography	0	0.0
Bedrock	0	0.0
Wetness	0	0.0
Organic	0	0.0
Marsh	149	7.0
Unclassified	10	0.5
Water	14	0.7
Total	2122	100.0

[1] Based on the **dominant** soil series and slope gradient within each polygon.

Management Considerations Map



Agricultural Capability Map.

This evaluation utilizes the 7 class Canada Land Inventory system (CLI, 1965). Classes 1 to 3 represent the prime agricultural land, class 4 land is marginal for sustained cultivation, class 5 land is capable of perennial forages and improvement is feasible, class 6 land is capable of producing native forages and pasture but improvement is not feasible, and class 7 land is considered unsuitable for dryland agriculture. Subclass modifiers include structure and/or permeability (D), erosion (E), inundation (I), moisture limitation (M), salinity (N), stoniness (P), consolidated bedrock (R), topography (T), excess water (W) and cumulative minor adverse characteristics (X).

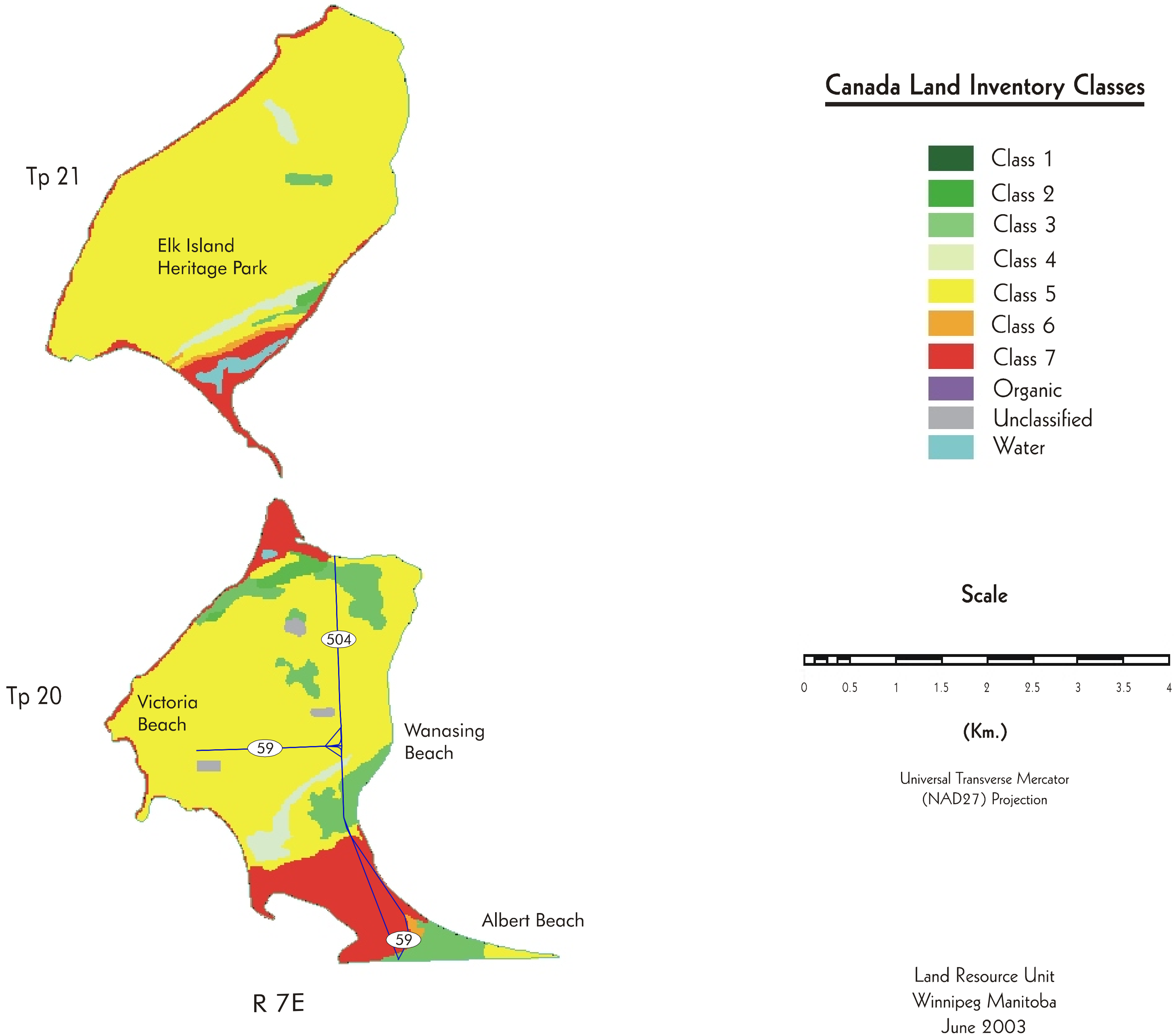
This generalized interpretive map is based on the dominant soil series and phases for each soil polygon. The CLI subclass limitations cannot be portrayed at this generalized map scale.

Table 5. Agricultural Capability[1]

Class Subclass	Area (ha)	Percent of RM
2	**21**	**1.0**
2M	21	1.0
3	**136**	**6.4**
3M	65	3.1
3W	70	3.3
4	**53**	**2.5**
4M	53	2.5
5	**1614**	**76.0**
5M	1508	71.0
5MT	20	0.9
5W	86	4.0
6	**14**	**0.6**
6W	14	0.6
7	**264**	**12.4**
7	33	1.6
7M	77	3.6
7T	4	0.2
7W	149	7.0
Unclassified	**10**	**0.5**
Water	**14**	**0.6**
Organic	**0**	**0.0**
Total	**2124**	**100.0**

[1] Based on the **dominant** soil series and slope gradient within each polygon.

Agriculture Capability Map



Irrigation Suitability Map.

Irrigation ratings are based on an assessment of the most limiting combination of soil and landscape conditions. Soils in the same class have a similar relative suitability or degree of limitation for irrigation use, although the specific limiting factors may differ. These limiting factors are described by subclass symbols at detailed map scales. The irrigation rating system does not consider water availability, method of application, water quality, or economics of irrigated land use.

Irrigation suitability is a four class rating system. Areas with no or slight soil and/or landscape limitations are rated **Excellent** to **Good** and can be considered irrigable. Areas with moderate soil and/or landscape limitations are rated as **Fair** and considered marginal for irrigation providing adequate management exists so that the soil and adjacent areas are not adversely affected by water application. Soil and landscape areas rated as **Poor** have severe limitations for irrigation.

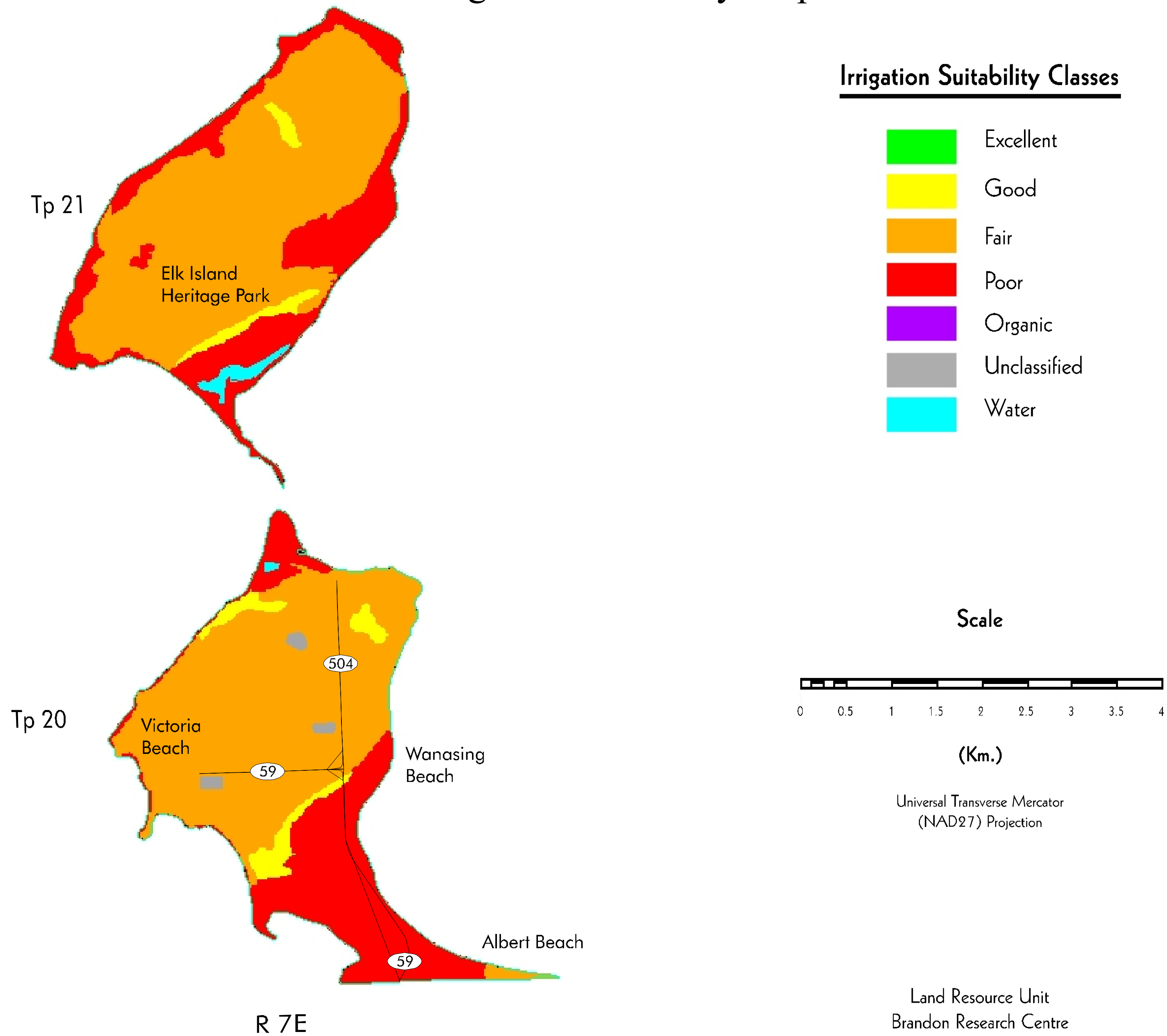
This generalized interpretive map is based on the dominant soil series for each soil polygon, in combination with the dominant slope class. The nature of the subclass limitations and the classification of subdominant components is not shown at this generalized map scale.

Table 6. Irrigation Suitability[1]

Class	Area (ha)	Percent of RM
Excellent	**0**	**0.0**
Good	**77**	**3.6**
Fair	**1409**	**66.4**
Poor	**611**	**28.8**
Organic	**0**	**0.0**
Unclassified	**10**	**0.5**
Water	**14**	**0.7**
Total	**2122**	**100.0**

[1] Based on the **dominant** soil series and slope gradient within each polygon.

Irrigation Suitability Map



Land Resource Unit
Brandon Research Centre
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Potential Environmental Impact Under Irrigation Map.

A major environmental concern for land under irrigated crop production is the possibility that surface and/or ground water may be impacted. The potential environmental impact assessment provides a relative rating of land into 4 classes (minimal, low, moderate and high) based on an evaluation of specific soil factors and landscape conditions that determine the impact potential.

Soil factors considered are those properties that determine water retention and movement through the soil; topographic features are those that affect runoff and redistribution of moisture in the landscape. Several factors are specifically considered: soil texture, hydraulic conductivity, salinity, geological uniformity, depth to water table and topography. The risk of altering surface and subsurface soil drainage regimes, soil salinity, potential for runoff, erosion and flooding is determined by specific criteria for each property.

Use of this rating is intended to serve as a warning of potential environmental concern. It may be possible to design and/or give special consideration to soil-water-crop management practices that will mitigate any adverse impact.

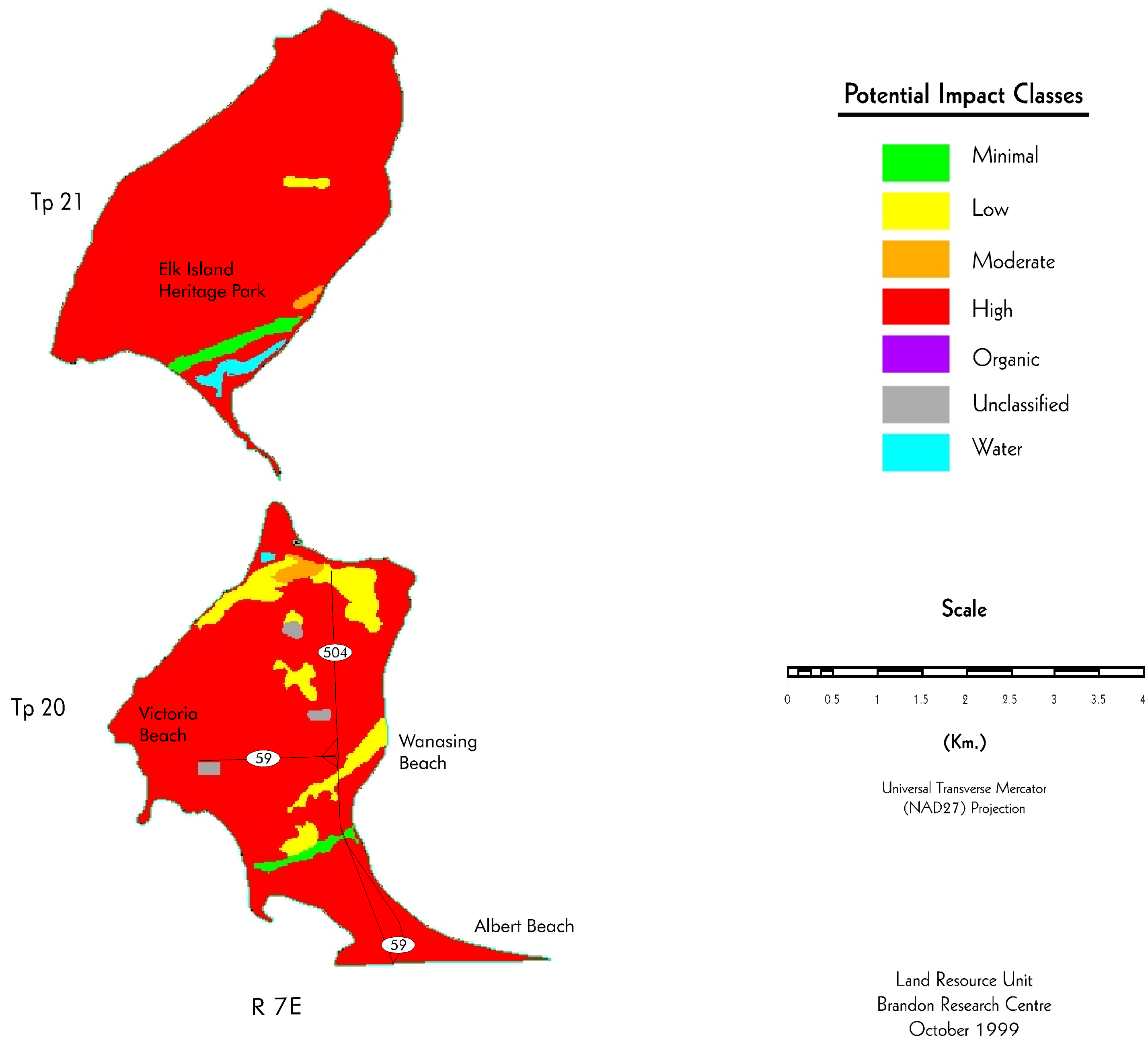
This generalized interpretive map is based on the dominant soil series and slope class for each soil polygon. The nature of the subclass limitations, and the classification of subdominant components is not shown at this generalized map scale.

Table 7. Potential Environmental Impact Under Irrigation[1]

Class	Area (ha)	Percent of RM
Minimal	**34**	**1.6**
Low	**111**	**5.2**
Moderate	**15**	**0.7**
High	**1938**	**91.3**
Organic	**0**	**0.0**
Unclassified	**10**	**0.5**
Water	**14**	**0.7**
Total	**2122**	**100.0**

[1] Based on the **dominant** soil series and slope gradient within each polygon.

Potential Environmental Impact Under Irrigation



Water Erosion Risk Map.

The risk of water erosion was estimated using the universal soil loss equation (USLE) developed by Wischmeier and Smith (1965). The USLE predicted soil loss (tons/hectare/year) is calculated for each soil component in each soil map polygon. Erosion risk classes are assigned based on the weighted average soil loss for each map polygon. Water erosion risk factors include mean annual rainfall, slope length, slope gradient, vegetation cover, management practices, and soil erodibility. The map shows 5 classes of soil erosion risk based on bare unprotected soil:

negligible
low
moderate
high
severe

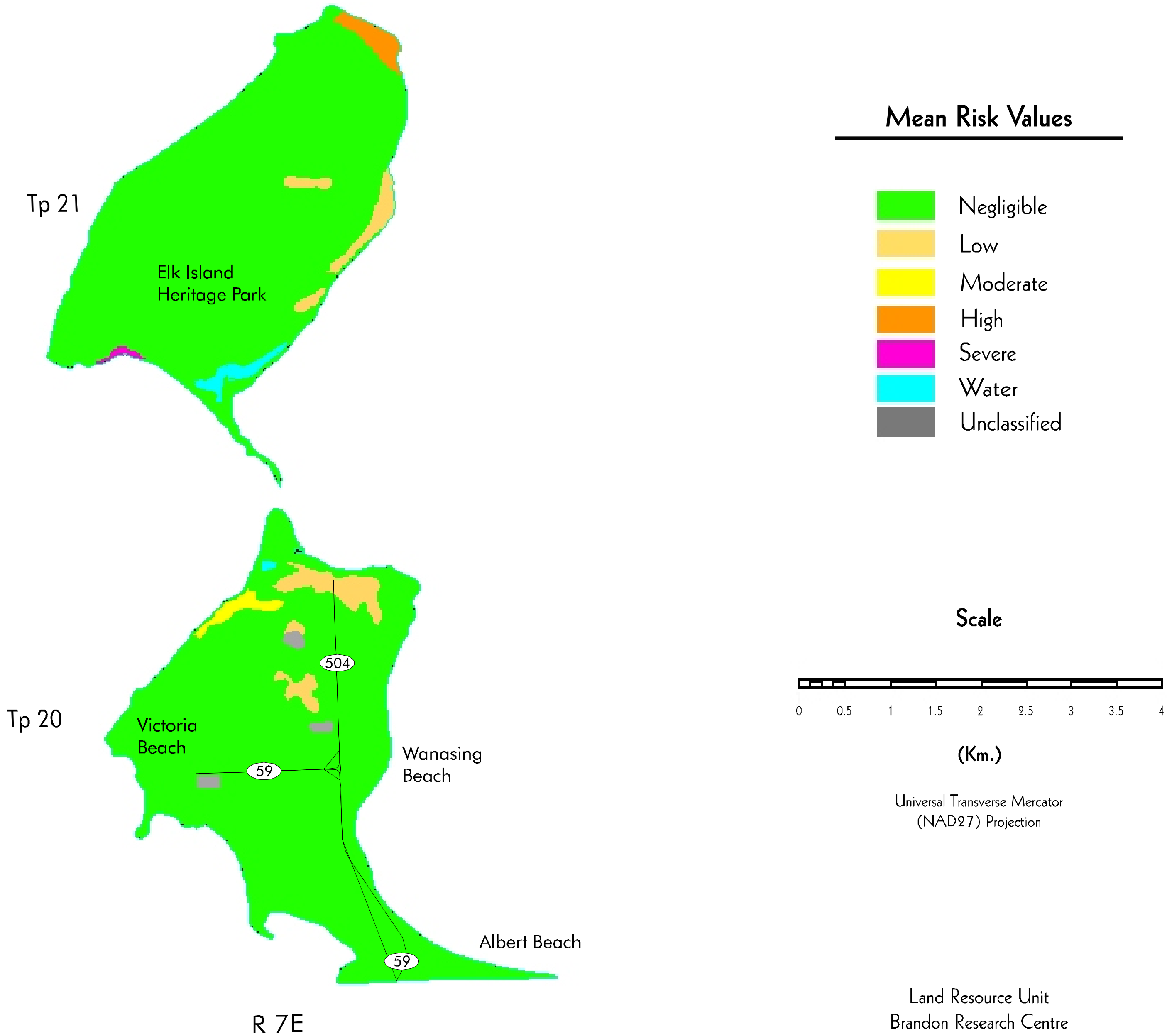
Cropping and residue management practices will significantly reduce this risk depending on crop rotation program, soil type, and landscape features.

Table 8. Water Erosion Risk[1]

Class	Area (ha)	Percent of RM
Negligible	**1985**	**93.5**
Low	**75**	**3.5**
Moderate	**14**	**0.7**
High	**20**	**0.9**
Severe	**4**	**0.2**
Unclassified	**10**	**0.5**
Water	**14**	**0.7**
Total	**2122**	**100.0**

[1] Based on the **weighted average** USLE predicted soil loss within each polygon, assuming a bare unprotected soil.

Water Erosion Risk Map



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